

The K-Space Segmentation Tool Set

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ABSTRACT

In this paper we describe two applications, created as part of the K-Space Network of Excellence, designed to allow researchers to use and experiment with state-of-the-art methods for spatial segmentation of images and video sequences. The first of these tools is an *Interactive Segmentation Tool*, developed to allow accurate human-guided segmentation of semantic objects from images using different segmentation algorithms. The tool is particularly useful for generating ground-truth segmentations, extracting objects for further processing, and as a general image processing application. The second tool we developed is designed for fully automatic spatial region segmentation of image and video. The tool is web-based; usage only requires a browser.

Both the automatic and interactive segmentation tools have been made available online¹; we anticipate they will be a valuable resource for other researchers.

1. INTRODUCTION

The primary focus of the K-Space² project is on narrowing the “semantic-gap” between the low-level multimedia content descriptors that can be computed automatically using currently available algorithms, and the high-level semantic descriptions afforded by human interpretation. Many current approaches to generating semantically meaningful content descriptors of images and video require an initial spatial partitioning of the content into coherent regions or objects. For example, recently several promising systems have been proposed that use knowledge assisted analysis to perform reasoning on the regions present in a segmentation, and automatically assign textual labels to these regions [6].

¹The interactive segmentation tool can be downloaded from <http://kspace.cdvp.dcu.ie/public/interactive-segmentation>. The web-segmentation tool is available from <http://kspace.cdvp.dcu.ie/platform/platform.html>

²K-Space - Knowledge Space of Semantic inference for automatic automatic annotation and retrieval of multimedia content (FP6-027026).

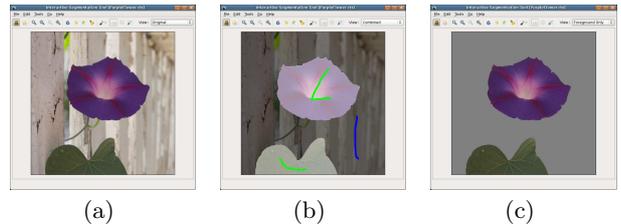


Figure 1: Screenshots of the interactive segmentation tool, running on the Linux platform: (a) original image, (b) hybrid-view, (c) extracted object.

Since spatial segmentation is such an important component in these content analysis systems, we decided to develop some tools to allow us to experiment with and evaluate the many available algorithms. In the remainder of the paper we will describe in more detail the functionality of the tools, the integrated algorithms, and some related research.

2. INTERACTIVE SEGMENTATION TOOL

The interactive segmentation tool enables users to extract objects from images, simply by marking areas as of the image as “object” or “background” with the mouse. The tool runs on all of the most common desktop operating systems, including Windows, Linux and Mac OSX. Figure 2 shows a screenshot of the tool.

To extract an object from an image, users mark object pixels using the left mouse-button, and background pixels using the right mouse-button. As each interaction is performed, the segmentation is automatically updated. The resulting segmentation masks can be visualized within the tool in various ways; this includes: a hybrid-view showing the segmentation mask transparently overlaid on the image, a view showing the object borders, and a view of the object with the background removed.

The tool can read and write all common image formats, and provides useful features found in other modern graphics packages, including brush size calibration, zoom-in/zoom-out, and undo/redo support.

Any segmentation technique that can be adapted to a “scribble” driven interaction paradigm for providing iterative updates can be integrated into the tool. To date we have integrated four such algorithms:

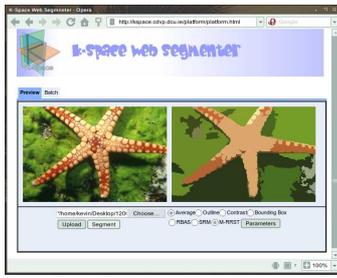


Figure 2: A screenshot of the web segmentation tool

1. The *seeded region growing* algorithm [2]: simple a technique for segmenting images where the relevant regions are characterized by connected pixels with similar color values.
2. The *interactive graph cut algorithm* [3]: a popular graph cut based algorithm.
3. The *simple interactive object extraction* algorithm [4]: an algorithm that uses marked pixels to build a color model of the object and background regions.
4. And the *interactive segmentation using binary partition trees* algorithm [1]: an algorithm that transforms a hierarchical region segmentation into an object segmentation by using the user interactions to split and merge regions in the tree.

The tool allows the user to change the algorithm being used at any stage of the segmentation process. It also allows any user-tunable parameters to be easily changed, and the effects visualized immediately.

3. WEB SEGMENTATION PLATFORM

The web segmentation platform is a web-based variant of the K-Space region segmentation tool, described in [5]. This version contains much of the same features and functionality as the original version, with the added advantage that the only software required to run it is a web browser. Figure 3 shows a screenshot of the platform.

The tool operates as follows: to segment a single image, the user selects the image using the web interface and uploads it to the server. The desired algorithm can then be chosen, and parameters configured if necessary. When the user clicks segment, the image is partitioned, and the results are displayed. The user can then visualize the resulting segmentation in a different ways using radio buttons.

To segment several images at once, or to segment a video sequence, the user can use the batch processing tab. On this tab the user can upload videos or archives of images; when segmentation is complete, the results are compiled into an archive and presented to the user.

Currently, only a subset of the algorithms available in the original tool are available: the *Statistical Region Merging* algorithm and two variants of the *Modified RSST* algorithm. See [5] for references and a more detailed description of these algorithms.

4. CURRENT AND FUTURE WORK

For the K-Space TRECVID submissions (e.g. [7]) we used the region segmentation tools to spatially segment content for extracting localized MPEG-7 descriptors to be used in the feature detection and search tasks. The same tools were also used to evaluate and compare the algorithms each of the integrated algorithms in [5]. We have also used the interactive tool in an extensive study evaluating and comparing algorithms for interactive segmentation. The results of the study have been submitted for publication in Pattern Recognition.

We are currently investigating the use of texture features for interactive image segmentation. To this end, we are integrating texture based versions interactive segmentation algorithms into the interactive tool; we will continue to update the online version with the latest developments.

5. CONCLUSION

We have presented two applications for automatic and interactive segmentation of images and video. The applications are currently being used for various activities and experiments by the K-Space NoE. By making them freely available to the research community, we hope that other researchers in segmentation and multimedia semantics will find them as valuable as we have.

6. REFERENCES

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